In re Application of:	BOERTJES, David W. et al.
Serial No.:	10/029,282
Filed:	28-12-2001
Title:	PROGRAMMABLE OADM WITH CHROMATIC DISPERSION, DISPERSION SLOPE AND AMPLITUDE RIPPLE COMPENSATION, AND METHOD
Group:	1773
Examiner:	LEUNG, Chrinstina Y
Attorney Ref.:	PAT 2682-2

Declaration under 37 CFR 1.131

The undersigned, David Boertjes, hereby declares on information and belief:

1) I am the first named inventor of the instant patent application.

2) During my employment with the Assignee, Nortel Networks Limited (NNL), I was personally involved with the preparation and internal submission of a corporate NNL invention disclosure related to the subject matter contained within the instant patent application which is attached as Exhibit A.

3) The NNL invention disclosure (Exhibit A) was submitted to the NNL patent department no later than 10 October 2000.

4) A review process and subsequent patent application preparation occurred between at least 10 October 2000 and the time the instant patent application was filed on 28 December 2001.

5) I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 USC 1001 and that such willful false statements may jeopardize the validity of the instant application or any patent issued thereon.

David Boertjes Date Aug 30, 2005

Declared before me on the 30th day of August, 2005, at Ottawa, Ontario, Canada.

Jeffrey M. Measures
A Notary Public for the Province of Ontario
My commission is indefinite.

In re Application of:	BOERTJES, David, W.; HINDS, Mark, R.; PARSONS, Kieran, J.; PARRY, Simon, Paul
Serial No.:	10/029,282
Filed:	December 28, 2001
Title:	PROGRAMMABLE OADM WITH CHROMATIC DISPERSION, DISPERSION SLOPE AND AMPLITUDE RIPPLE COMPENSATION, AND METHOD
Group:	1773
Examiner:	Christina Y. Leung
Attorney Ref.:	PAT 2682-2 US

EXHIBIT A

Jeffrey M. Measures

Invention Disclosure Submission Reply

Disc No:	13596RO	**Received Date:**	10 oct 2000
Disclosure Title:	Programmable OADM Architecture with Chromatic Dispersion, Dispersion Slope and Amplitude Ripple Compensation		

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---═══ Attachments ═══---

File Name	File Type	File Comments
ProblemBeingSolved.pdf	PDF (Adobe)	this is the problem addressed by the invention
PriorArt.pdf	PDF (Adobe)	this is a summary of the prior art
OADM_Architecture.pdf	PDF (Adobe)	this is the suggested embodiment for the architecture
wavelength_plans.pdf	PDF (Adobe)	this is an example of different wavelength plans for OADM using the basic assumption that if the sub-bands are 4 channels in size, it is necessary to skip 2 channels in the dead-bands to limit system penalty.

<End of Attachments>

Were there additional inventors involved:	yes	**Was there contractor involvement:**	no
Name of Supervisor or Divisional Head:		**Name of VP:**	
STAN BLAKEY		RICHARD COWPER	
LOB:	SP&C	**Business Unit:**	OPTICAL NETWORKS
Conception Date:			
Has this invention been discussed with others? If so, please complete:			
Inside Nortel - Whom?		**Outside Nortel - Whom?**	
Inside Nortel - When?		**Outside Nortel - When?**	
NDA?	yes		
Are you aware of any imminent future disclosures? Please provide dates and details:			

Keywords for Searching:	**Products that will use this invention:**
OADM, reconfigureable, chromatic dispersion, WDM, dispersion slope	Optera LH5000

Does this invention arise from any arrangement involving an external organization?	no
Is this invention relevant to a Standards Activity?	**Internal Funding Project #'s:**
no	251-23689

If so, give details:

Technical Information

Brief Description of the Invention:

This invention is an optical architecture for a programmable (or reconfigurable) optical add/drop multiplexer (OADM). The architecture is intended to support both local termination of traffic and optical cross-connect of multiple systems.

Problem Solved by the Invention:

In particular, the architecture addresses the main problems in cross-connecting long-haul systems including coherent crosstalk (or MPI), amplitude equalization and chromatic dispersion.

Solutions that have been tried and why they didn't work:

1. Multiple cascaded three-port filters are commonplace, but have the drawback of not being programmable, introducing MPI, etc. The MPI is introduced through the "reflective" express path on which the non-add/drop traffic is routed.
2. Tunable filters are sometimes cited in the literature, but are, in general, unable to be reconfigured without affecting some other traffic on the line other than that being switched.

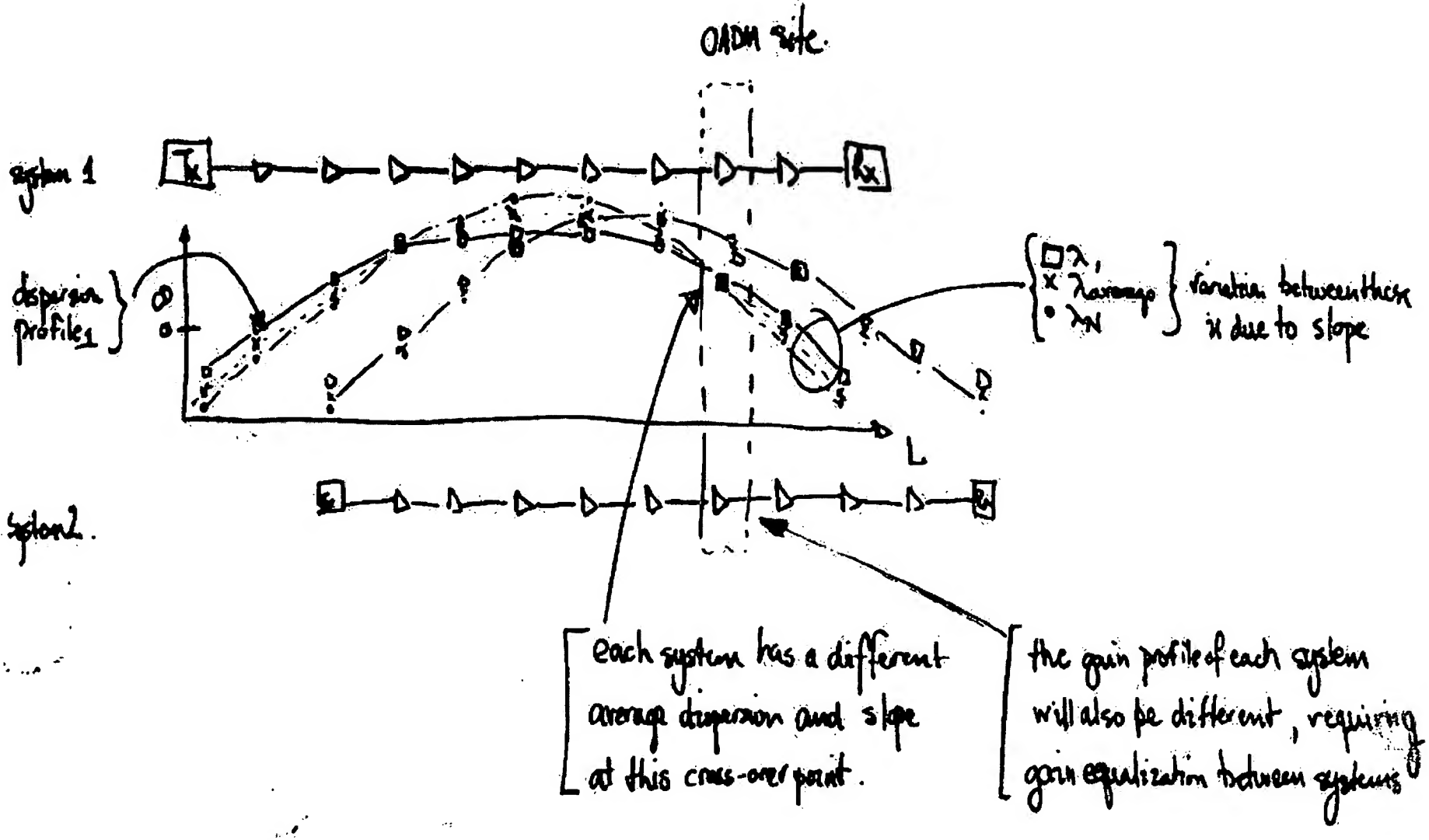
Specific elements or steps that solved the problem and how they do it:

1. Use of sub-banded MUX and DeMUX WITHOUT a "reflective" express path to limit MPI. Sub-bands may have one or more channels. More channels results in less optical components (reduced cost) at the expense of less flexibility and a possible penalty due to equalization. Less channels can reduce spectral efficiency of the system if there is a need for inter-sub-band dead-bands.
2. Introduction of small inter-sub-band dead-bands to mitigate filtering penalty. This may not be necessary for all systems.
3. Placement of an array of 2x2 optical switches in the mid-stage of the MUX/DeMUX pair to perform add/drop function.
4. Optional second set of MUX/DeMUX optics for all optical cross-connect in overlapping system add/drop.
5. Addition of variable optical gain (attenuation or optical amplification) in the MUX/DeMUX mid-stage (one for each sub-band) for sub-band power equalization.
6. Addition of chromatic dispersion compensation elements in the MUX/DeMUX mid-stage (one for each sub-band) for chromatic dispersion and slope of dispersion equalization.
7. Split of the usual dispersion compensator that resides in the amplifier mid-stage into two parts that surround the OADM. By repeating this for two overlapping systems, a common dispersion target can be set for both systems inside the OADM.
8. Extension of this idea to more than 2 overlapping systems, say N such systems, can be done by introducing more MUX/DeMUX pairs and replacing the 2X2 switches described above by NXN switches.
9. Extension of this idea to cover combined overlapping systems and local termination of certain channels can be acheived by using certain pairs of sub-bands for the local and continuing traffic appropriately. The dispersion target in the OADM can be adjusted appropriately as well.
10. Extension of this idea to cover only part-bands can be acheived by providing a "reflective" express path for a portion of the band which is not MUXed or DeMUXed by the optical WDM filters. This is done at the expense of MPI.

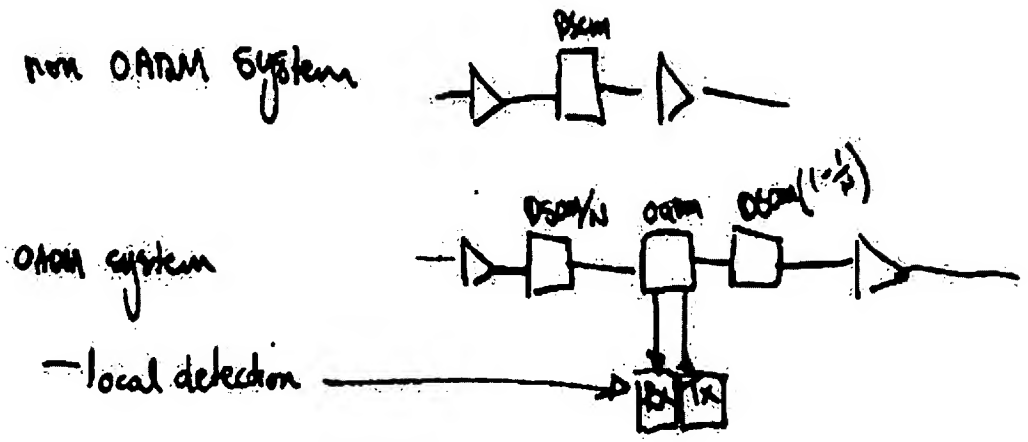
Commercial value of the invention to Nortel and Nortel's major competitors:

This is a flexible OADM which maintains system performance and simplifies the complexities associated with inter-system traffic.

Overlapping systems (drop and continue):

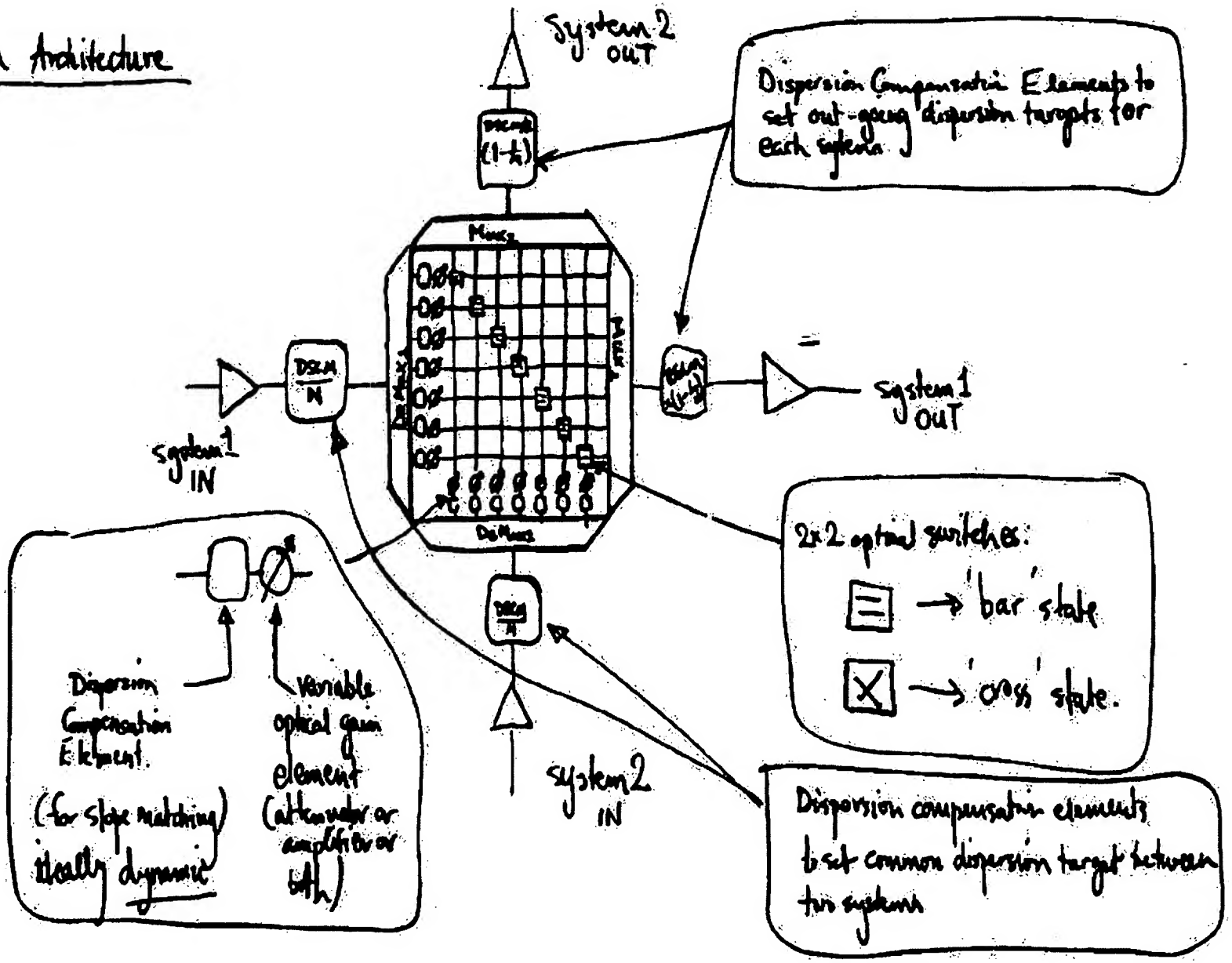


Prior Art:



- limited ability to support 'drop and Continue' ie. overlapping systems.
- requires regen. to provide gain equalization and dispersion mitigation between systems.

OADM Architecture



Express option 2.0.1

xC-Band

WDM Group	Channel Number	F (THz)	λ (nm)
1	1	196.200	1527.994
	2	196.100	1528.773
	3	196.000	1529.553
	4	195.900	1530.334
2	5	195.800	1531.116
	6	195.700	1531.898
	7	195.600	1532.681
	8	195.500	1533.465
3	9	195.400	1534.250
	10	195.300	1535.036
	11	195.200	1535.822
	12	195.100	1536.609
4	13	195.000	1537.397
	14	194.900	1538.186
	15	194.800	1538.976
	16	194.700	1539.766
5	17	194.600	1540.557
	18	194.500	1541.349
	19	194.400	1542.142
	20	194.300	1542.936
6	21	194.200	1543.730
	22	194.100	1544.526
	23	194.000	1545.322
	24	193.900	1546.119
7	25	193.800	1546.917
	26	193.700	1547.715
	27	193.600	1548.515
	28	193.500	1549.315
8	29	193.400	1550.116
	30	193.300	1550.918
	31	193.200	1551.721
	32	193.100	1552.524
9	33	193.000	1553.329
	34	192.900	1554.134
	35	192.800	1554.940
	36	192.700	1555.747
10	37	192.600	1556.555
	38	192.500	1557.363
	39	192.400	1558.173
	40	192.300	1558.983
11	41	192.200	1559.794
	42	192.100	1560.606
	43	192.000	1561.419
	44	191.900	1562.233
12	45	191.800	1563.047
	46	191.700	1563.863
	47	191.600	1564.679
	48	191.500	1565.496

No OADM with 48 total channels

OADM option 2.0.2

xC-Band

WDM Group	Channel Number	F (THz)	λ (nm)
1	1	196.200	1527.994
	2	196.100	1528.773
	3	196.000	1529.553
	4	195.900	1530.334
		195.800	1531.116
		195.700	1531.898
2	5	195.600	1532.681
	6	195.500	1533.465
	7	195.400	1534.250
	8	195.300	1535.036
		195.200	1535.822
		195.100	1536.609
3	9	195.000	1537.397
	10	194.900	1538.186
	11	194.800	1538.976
	12	194.700	1539.766
4	13	194.600	1540.557
	14	194.500	1541.349
	15	194.400	1542.142
	16	194.300	1542.936
5	17	194.200	1543.730
	18	194.100	1544.526
	19	194.000	1545.322
	20	193.900	1546.119
6	21	193.800	1546.917
	22	193.700	1547.715
	23	193.600	1548.515
	24	193.500	1549.315
7	25	193.400	1550.116
	26	193.300	1550.918
	27	193.200	1551.721
	28	193.100	1552.524
8	29	193.000	1553.329
	30	192.900	1554.134
	31	192.800	1554.940
	32	192.700	1555.747
		192.600	1556.555
		192.500	1557.363
9	33	192.400	1558.173
	34	192.300	1558.983
	35	192.200	1559.794
	36	192.100	1560.606
		192.000	1561.419
		191.900	1562.233
10	37	191.800	1563.047
	38	191.700	1563.863
	39	191.600	1564.679
	40	191.500	1565.496

16 OADM channels with 40 total channels

OADM option 2.0.3

xC-Band

WDM Group	Channel Number	F (THz)	λ (nm)
1	1	196.200	1527.994
	2	196.100	1528.773
	3	196.000	1529.553
	4	195.900	1530.334
		195.800	1531.116
		195.700	1531.898
2	5	195.600	1532.681
	6	195.500	1533.465
	7	195.400	1534.250
	8	195.300	1535.036
		195.200	1535.822
		195.100	1536.609
3	9	195.000	1537.397
	10	194.900	1538.186
	11	194.800	1538.976
	12	194.700	1539.766
		194.600	1540.557
		194.500	1541.349
4	13	194.400	1542.142
	14	194.300	1542.936
	15	194.200	1543.730
	16	194.100	1544.526
		194.000	1545.322
		193.900	1546.119
		193.800	1546.917
		193.700	1547.715
5	17	193.600	1548.515
	18	193.500	1549.315
	19	193.400	1550.116
	20	193.300	1550.918
		193.200	1551.721
		193.100	1552.524
6	21	193.000	1553.329
	22	192.900	1554.134
	23	192.800	1554.940
	24	192.700	1555.747
		192.600	1556.555
		192.500	1557.363
7	25	192.400	1558.173
	26	192.300	1558.983
	27	192.200	1559.794
	28	192.100	1560.606
		192.000	1561.419
		191.900	1562.233
8	29	191.800	1563.047
	30	191.700	1563.863
	31	191.600	1564.679
	32	191.500	1565.496

32 OADM channels with 32 total channels